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CONTENTS

UNITED STATES MOTOR GASOLINE

For the past five years the following distillation range has determined the volatility of United States Government motor gasoline:

Initial point, not more than 55° C. (131° F.).

20 per cent point, not more than 105° C. (221° F.).

50 per cent point, not more than 140° C. (284° F.).

90 per cent point, not more than 200° C. (392° F.).

End point, not more than 225° C. (437° F.).

Recovery, at least 95 per cent.

During this period the semiannual motor gasoline surveys conducted by the Bureau of Mines have indicated that the average motor fuel sold throughout the country was considerably more volatile even in summer than the gasoline likely to be furnished under the above specification, while fuel research at this bureau has indicated that the 10 per cent point and 90 per cent point furnish the most reliable criteria of the relative volatility of fuels for use in automotive engines.

Consequently the Federal Specifications Board has issued recently a revised Federal Specification (U. S. G. M. S. 622a) for motor gasoline which substitutes for the initial point and 20 per cent point the following requirement:

> When 10 per cent has been recovered in the receiver, the thermometer shall not read more than 80° C. (176° F.) nor less than 50° C. (122° F.); provided that, for each per cent distillation loss less than 4 per cent, obtained in the A. S. T. M. distillation, the minmum 10 per cent temperature requirements shall be lowered 3° C. (5.4° F.).

Government purchasing officers are authorized to contract for motor gasoline having a maximum 10 per cent point of 75° C. (167° F.) or 70° C. (158° F.) to meet low temperature conditions. The purpose of the minimum 10 per cent point at 50° C. (122° F.) is to eliminate gasolines of abnormally high vapor pressure which are subject to excessive losses on storage and may boil in the fuel lines under high temperature conditions. The specification permits raising the minimum 10 per cent point to 60° C. (140° F.) in the case of gasolines intended for tropical storage.

A separate Federal Specification (U. S. G. M. S. 623) has been written for a special grade of fuel to be used for ambulances, fire engines, and other emergency vehicles. This fuel is called motor fuel V and is intermediate between motor gasoline and aviation gasoline.

MORE EFFICIENT USE OF CUTTING FLUIDS IN MACHINE-SHOP PRACTICE

The Bureau of Standards has been cooperating with the Special Research Committee on Cutting of Metals, American Society of Mechanical Engineers, in coordinating the information available on cutting fluids, and in planning a 2-year program of experimental investigation. At the present time the practices in different shops are widely divergent. More efficient selection and use of cutting fluids should result in reduced costs of production of metals parts in every manufacturing industry.

Progress Report No. 1 of the subcommittee on cutting fluids, entitled "Cooling and Lubrication of Cutting Tools," has recently appeared in Transactions, American Society of Mechanical Engineers (Vol. 51, M S P No. 8, 1929, pp. 47 to 58) together with a first installment of the discussion received. The report begins with a review of the many unsettled, and sometimes mysterious, questions of cutting-fluid performance which led to the necessity for a general program of research. Afterward there is given a brief outline of some results already obtained from the preliminary experimental work. The report concludes with two appendixes containing (1) a classified bibliography of cutting fluids literature (64 references), and (2) a blank chart for tabulating current shop practice in the use of cutting fluids.

Progress Report No. 2 of the subcommittee, compiled by S. A. McKee, and entitled "Present Practice in the Use of Cutting Fluids," is scheduled for presentation and discussion at the annual meeting of the American Society of Mechanical Engineers on Tuesday afternoon, December 3, 1929. Preprints can be obtained from the above society, 29 West Thirty-ninth Street, New York, N. Y. This report is based upon information contributed by 68 of the large users of cutting fluids in this country. More than 12,000 individual returns were actually utilized in compiling the nine tables presented in the report. The first table lists the number of plants using any of three general types of cutting agent (dry cutting, water or water emulsions, and oils or oil mixtures) for each of 19 machining operations on 8 kinds of metals. Each of the remaining tables gives more detailed information regarding the cutting agents used for the various operations on a given metal.

The following basic materials had been used in making up the numerous cutting agents reported: Water, soda, animal fats and oils, vegetable and mineral oils, carbon tetrachloride, turpentine, sulphur, soap, white lead, beeswax, talc, lampblack, petrolatum, and compressed air (in the form of air blast).

The statistics obtained illustrate the chaotic condition of present-day American practice mentioned above and suggest the importance of experiments which will make it practicable to classify and specify cutting fluids on the basis of their essential physical properties, such as oiliness, viscosity, thermal conductivity, and the like, rather than on the basis of chemical composition. This requires experiments on cutting of metals planned in such a manner as to bring out whatever correlations may exist between a minimum number of basic physical properties on the one hand and the measured cutting performance of the fluid on the other hand. Quantitative relations are ultimately sought for, such as have already been successfully obtained in the field of bearing lubrication. It is recognized, however, that the problems of cutting-fluid performance are inherently more complex than the analogous problems of bearing lubrication.

THE STORMER AND OTHER ROTATION VISCOMETERS

For measuring viscosity either the capillary tube or the rotation viscometer is generally used. Much less has been written about the latter than about the former type of instrument.

The essential requirement of a rotation viscometer is that there shall be relative motion between two parallel surfaces, and this is most readily attained by the use of two coaxial cylinders. If d_1 is the outside diameter of the smaller cylinder and d_2 the inner diameter of the

larger cylinder, the cylinders are separated by a space of thickness

$$\frac{d_2-d_1}{2}$$

which is filled with the liquid to be tested. With such an instrument, assuming that there is no friction, turbulence, or "end effect" (i. e., assuming that the viscous resistance is the same as for a portion of equal length of an infinitely long cylinder), the absolute viscosity is given by the equation

$$\mu=\frac{30Wgr(d_2^2-d_1^2)}{\Pi^3 hNd_2^2 d_1^2}=\frac{CW}{hn} \qquad (1)$$

where

μ = absolute viscosity in poises.

Wgr = turning moment in dyne centimeters due to a weight or weights W, in grams, acting at an effective radius, r, in cm.

h = height of cylinder, in cm, wetted by the liquid.

N = speed of rotating cylinder, in revolutions per minute.

Equation (1) is valid either when the inner or the outer cylinder rotates. With the Stormer viscometer the inner cylinder is rotated by a weight,, while the outer cylinder is stationary. With the improved MacMichael viscometer [1] N is the speed of rotation of the outer cylinder, the inner cylinder being stationary at the time the reading is made. As the Stormer viscometer is ordinarily used with the inner cylinder totally submerged, the wetted height can not be varied, and, therefore, the end effect can not be evaluated.

In cases where the inner cylinder is not submerged and equation (1) is applicable, the rate of shear is equal to

$$\frac{\Pi d_2^2 d_1^2 N}{60\,(d_2^2-d_1^2)R^2}$$

where R is the distance from the axis of rotation to any point under consideration. The mean rate of shear over the entire cross section is given by

$$\frac{\Pi N d_2^2 d_1^2 \log_e \frac{d_2}{d_1}}{7.5\,(d_2^2-d_1^2)^2}.$$

It should be noted that the rate of shear, although expressed in radians per second, must not be confused with the speed of the rotating cylinder, which, expressed in the same unit, is equal to

$$\frac{2\Pi N}{60}.$$

The practical difficulties arising in the construction of this theoretically simple instrument are those connected with the exact measurement of the small turning moments involved, avoidance of turbulence, and the evaluation or elimination of frictional forces. The end effects are usually evaluated by two or more measurements of viscosity with different wetted heights. The instrumental constant, C, may then be calculated from the dimensions. The constancy for the values for viscosity of a simple viscous liquid at different rates of shear, after the end correction has been applied, is sufficient evidence of the correctness of the design.

The following directions indicate the usual method of reporting results with the Stormer viscometer:

> Take the time for 100 revolutions with water as unity. Then the relative viscosity of another fluid will be the time required for 100 revolutions divided by the time for 100 revolutions in water. If a liquid is found too viscous for comparison with water, first determine the viscosity of an intermediate liquid as standard. After this calculate back to water as unity.

This use of so-called relative viscosity is objectionable because viscosity is not proportional to time unless there is no turbulence, which can not be assumed with water.

Since some time is required to accelerate the inner cylinder, it should be allowed to attain a constant speed before starting to measure the time for 100 revolutions. From equation (1) the viscosity should be proportional to the product of the driving weight by the time for 100 revolutions, but some method of correcting for pivot friction is necessary. Higgins and Pitman,[2] using a modified form of equation, found for their Stormer instrument

$$\text{Viscosity in centipoises} = 4.6\,t - 25 \qquad (2)$$

which applies when a 150-g weight is used, and

$$\text{Viscosity in centipoises} = 9.3\,t - 30 \qquad (3)$$

for use with a 300-g weight. These equations do not apply for viscosities below 15 centipoises, but a diagram given by them for use in place of equation (3) for determining lower viscosities.

[1] The Improved MacMichael Viscometer; Winslow H. Herschel. J. Optical Soc. Am. and Rev. Sci. Insts., Vol. 7, p. 335; 1923 (U. S. Patent No. 1236706, of Aug. 14, 1917).

[2] Measurement of Viscosity of Pyroxylin Solutions. E. F. Higgins and E. C. Pitman; J. Ind. & Eng. Chem., vol. 12, p. 587; 1920.

If t, the time in seconds, for 100 revolutions is corrected for friction, a simple general equation, applicable even at low viscosities, may be used. With Higgins and Pitman's data, fairly concordant results may be obtained if this time correction is assumed as 4.5 seconds. Then the general equation for their instrument, with either weight, is approximately

$$\mu = 0.000313\, W\, T \qquad (4)$$

where T is the corrected time for 100 revolutions and is equal to $t - 4.5$ seconds, W is the driving weight in grams, and μ is the viscosity in poises.

ORIFICE METERS FOR MEASURING LARGE VOLUMES OF GAS

On page 11 of Technical News Bulletin No. 142 (February, 1929) a general statement was given on the progress up to that time of the orifice-meter investigation which has been carried on for several years by the measurement committee of the natural gas department of the American Gas Association in cooperation with the Bureau of Mines and the Bureau of Standards. During the past year considerable progress has been made toward completing the program of work which the committee has been following.

The first important step was a short series of high-pressure tests which were made in the Buttonwillow gas field, near Taft, Calif. In these tests the line pressures were increased to over 600 lbs./in.^{2}. Several tests were made on samples of the gas to determine the supercompressibility factor; that is, the amount by which the gas deviates from Boyle's law. As a result of these tests it was concluded that if the supercompressibility factor is correctly determined and applied to the meter computations, measurements by orifice meters may be made at high static pressures with the same degree of accuracy as at low pressures.

The next step was a series of tests at low pressure, on 16, 8, and 4 inch lines. These three test lines were used successively in series with a bank of 10-inch lines which were used as reference meters. The set-ups for the three lines were made as nearly geometrically similar as was conveniently possible without excessive alterations in the rest of the piping system. There were three important elements associated with these tests: First, it was possible to obtain almost any rate of flow up to 2,000,000 cubic feet per hour; second, because of this large flow it was possible to extend the ratio of orifice to pipe diameter to 0.86 (for example, a 7-inch orifice in the 8-inch line), and in the case of the 4 and 8 inch lines to increase the gas velocity through these large orifices up to about the critical velocity; third, the same set of reference lines could be used throughout and the set-up conditions for the three sizes of lines were approximately geometrically similar.

The most important conclusion that may be drawn from a preliminary study of the results is, that for the same diameter ratios the value of discharge coefficient of an orifice is independent of the actual pipe size; provided the installations are geometrically similar, including the design and location of straightening vanes. It also appears that when the static pressure is taken on the upstream side of the orifice, the coefficient-pressure ratio curve is very nearly a straight line.

In this investigation the bureau was fortunate in having the hearty cooperation of the industry, the assistance rendered by the Pacific Coast Gas Association and the California Natural Gasoline Association being particularly important.

PREPARATION OF VERY PURE PLATINUM SPONGE

The bureau has completed the preparation of about 500 g. of very pure platinum sponge. This preparation served once again to show the effectiveness of the method for the purification of platinum developed at the bureau and published in Transactions, American Institute of Mining and Metallurgical Engineers, volume 76, page 603, 1928. The starting material in this case was scrap platinum containing about 5 per cent of impurities, which included iridium, rhodium, palladium, ruthenium, gold, and iron, and doubtless small amounts of other metals. Gold was first precipitated by the addition of ferrous sulphate, after which the iron thus introduced, together with the other impurities mentioned, were precipitated by the addition of sodium bicarbonate to the boiling solution until it was very faintly alkaline. As described in the published method, sodium bromate was previously added to retard the reaction between platinum and the sodium bicarbonate. In the filtrate from this precipitation, platinum thus obtained was apparently at least 99.999 per cent pure. A second ammonium chloride precipitation was made for the purpose of eliminating the sodium chloride which was carried down in the first precipitation. The presence of small amounts of sodium chloride or similar salts in platinum sponge prevents the successful melting of the sponge in the high-frequency furnace. So far as could be detected, however, the reprecipitation with ammonium chloride did not

show the presence of any heavy metal impurities in the platinum. While this method of purification requires some experience in manipulation, it is very well suited to the rapid preparation of very pure platinum on a laboratory scale. There is no apparent reason why it could not be adapted to small scale and possibly even to full scale commercial refining of platinum.

The pyrometry section of the bureau has succeeded in setting up a fundamental standard of light to which other standards can be referred, following the procedure suggested by Waidner and Burgess in 1908.

This standard involves the use of a hollow inclosure (black body) immersed in a bath of molten platinum. Observations are taken of the light emitted from the interior of this inclosure during the period of solidification of the platinum. This proposal was recognized from the first as ideal, but seemed to present such experimental difficulties as to discourage any attempts actually to carry it out.

In order to withstand the extremely high temperature at which platinum melts—1,772 °C. (3,220 °F.)—a special refractory (fused thorium oxide) was developed. This accomplishment, together with recent improvements in high-temperature technique, such as the use of the high-frequency induction furnace, enabled the bureau to overcome seemingly insurmountable difficulties and to reduce the operation of the apparatus to a matter of laboratory routine. The brightness of the Waidner-Burgess standard in terms of the average value of the bureau's carbon-lamp standards was found to be 58.9 International Candles per square centimeter.

The great practical advantage of the Waidner-Burgess standard is the fact that it is based upon a fundamental constant of nature and will not change with time. It, therefore, offers a basic standard to which incandescent-lamp standards can be referred if desired. The successful experimental realization of this standard prepares the way for a proposal that it be adopted as an international standard. The outcome of such a proposal would, of course, depend upon the action of the various national laboratories and others concerned.

ULTRA-VIOLET SOLAR RADIATION

In connection with the bureau's investigation of the properties of special window glasses and glass substitutes for transmitting ultra-violet solar radiation of wave lengths less than 310 millimicrons, measurements were made at two elevations (7,250 and 10,500 feet) at Flagstaff, Ariz., to determine the amount of incoming ultra-violet radiation at these higher elevations as compared with a station practically at sea level, Washington. An interesting result is the observation that, while the spectral quality of the ultra-violet at the 10,500 feet station is appreciably different (being richer in short-wave length ultra-violet) from that at the 7,250 feet elevation, the total amount of ultra-violet, of wave lengths less than 310 millimicrons, for unit air mass, is practically the same at these two stations. This is the result of the increased scattering of ultra-violet radiation at the lower (7,250 feet) elevation.

RANGE OF RADIOBEACONS

An analysis of the electrical operation of the 12-course radio range was commenced last summer. It was found that this type of radiobeacon can furnish 12 courses for guiding airplanes along any desired courses regardless of the angles between them. Small changes in electrical characteristics occur during normal operation, but a study of the phase relations of the amplifier trains used in the transmitter showed that under conditions of practical operation the direction of courses was not affected by these changes. Another result of the special study of the design of this apparatus was a 60 per cent increase in power output. Besides this study upon the experimental beacon transmitter of the bureau, assistance was rendered the airways division of the Department of Commerce in connection with their work of constructing some of these beacons of visual indication type for use on the airways.

In September and October daily flight tests were made, and under the atmospheric conditions then prevailing course indications were obtained at distances of the order of 100 miles.

The results obtained through these flight tests brought out several minor refinements which tend to increase the reliability and efficiency of operation of this type of radio range. Refinements in the design of the special 3-reed indicator, which may be used for receiving any one of the 12 beacon courses, were also made. In particular, a switching arrangement, automatically operated by a shutter on the indicator front, was devised, whereby the pair of driving coils controlling the reed not in use are switched out of circuit. The sensitivity of the reed indicator is thus increased by about 15 per cent.

Measurements were also made of the performance of several reed indicators manufactured by a commercial aircraft-instrument company. In the course of these measurements it was observed that

the magnetic properties of the elinvar used for making the vibrating reeds may be improved by cold-rolling. The sensitivity of the reed indicators depends directly upon the magnetic properties of the reeds.

RADIO MARKER BEACONS

The bureau has found it necessary to give renewed attention to the design of marker beacons, for two purposes. One is the adaptation of the marker beacon principle for use at special points on the airways in connection with the visual beacon system. Another is the provision of marker beacons as auxiliaries in connection with fog-landing equipment. Recent work has been directed to determination of the best choice of indicator frequencies and antenna design. Results to date indicate that an indicator frequency of about 40 cycles will be satisfactory, being particularly free from the flutter type of interference which has been observed on the main beacon indicators when marker beacons were used in earlier experiments. Present experiments indicate that a loop antenna may be more satisfactory than an open type of antenna, particularly because there is a sudden drop of deflection of the marker beacon indicator when the airplane is directly over the marker beacon. This greatly improved sharpness of locating the marker beacon may be an important adjunct to the whole beacon system. Its value is expected to be particularly great in those cases where marker beacons are used as part of a fog-landing system, such as the bureau has installed at College Park, Md., and at Mitchel Field, Long Island, N. Y.

A circuit arrangement was devised whereby a marker beacon located at the junction of two main beacon courses may transmit simultaneously on the two radio-frequencies employed by the main beacons. The marker beacon signals may, therefore, be received whether the receiving set is tuned to one or the other of the two main beacon frequencies.

The reed indicator for receiving the marker beacon signals was redesigned in order to obtain increased sensitivity with reduced weight and size. The construction of four indicators of the new design has been started.

PROTECTION OF ELECTRICAL CIRCUITS AND EQUIPMENT AGAINST LIGHTNING

The bureau has issued as Miscellaneous Publication No. 95 a report dealing with the application of lightning arresters to electrical lines and equipment. The report has been drawn up by a committee of experts representing the various technical societies and others concerned with this subject. The protection of power, railway, signaling, and communication circuits and aparatus is described. The bulk of the report deals with the application of lightning arresters to power and railway circuits, but other methods of protection, such as the use of overhead ground wires, are also discussed.

Not only direct strokes of lightning, but induced surges upon overhead conductors, produce a great deal of trouble in the operation of the electrical utility services. This report points out how a proper selection and application of lightning arresters will greatly reduce such troubles and enable the utility companies to avoid frequent interruptions to their service from this cause.

The bureau wishes to emphasize the fact that this is only a preliminary report. Comments and suggestions from those interested will be welcomed. The investigation of the properties of lightning is now being carried out more intensively than ever before, and it is expected that within a short time our knowledge of lightning and of the methods of combating its effects will be greatly increased.

Copies of this publication may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 25 cents each.

FIRE RESISTANCE OF PLASTER PARTITIONS

A number of fire tests of solid and hollow plaster partitions, built by applying plaster on metal lath attached to metal studs, have been made recently in the bureau's small wall and partition furnace. The object of the tests here reported was primarily to learn the effect of different proportions of gypsum and sand in the plaster on temperature transmission through the partition. The solid partitions were built on a single layer of No. 24 gage lath (weighing about 3 pounds per square yard) attached to three-fourth inch plastering channels spaced about 12 inches apart. After the first scratch coat of plaster had set, one or more body coats were applied on each side to attain the desired thickness. For the hollow partitions, two metal lath and stud backings were spaced 3 inches apart by means of solid channel spacers, and two coats of plaster applied on the outside of each to give a plaster thickness of about three-fourth inch. The proportions of mix for the plaster were determined by dry weight of gypsum plaster and sand, respectively. No whitecoat finish was ap-

plied, the outer brown or body coats being floated to a smooth surface. The partitions were seasoned from 30 to 40 days under dry-room conditions before testing.

The partitions were tested as nonbearing partitions with fire exposure on one side controlled according to the standard testing procedure. The temperatures on the unexposed side were determined by means of thermometers under asbestos felt pads 0.4 inch thick and by means of thermocouples attached to the bare surface. The ultimate fire resistance of all these partitions was determined by an average temperature rise under the asbestos pads of 139° C. (325° F.) above the initial temperatures. No cracks were formed of sufficient size to pass flame or smoke.

The following table gives the ultimate fire resistance of the partitions as determined on the above basis. The periods have been rounded to the nearest five minutes and have been corrected so as to apply for even thicknesses of 2 and 2½ inches for the solid partitions. This was necessary as the partitions, as constructed, varied by one-eighth to one-fourth inch from these nominal thicknesses.

Ultimate fire resistance of plaster on metal lath and metal stud nonbearing partitions

Type	Plaster proportions by dry weight	Thickness	Ultimate fire resistance	
		Inches	*H.*	*M.*
Solid	1 gypsum: 3 sand	2		45
Do	1 gypsum: 2½ sand	2		50
Do	1 gypsum: 2 sand	2	1	00
Do	1 gypsum: 2½ sand	2½	1	10
Hollow	1 gypsum: 2½ sand; plaster ¾ inch thick on each side	4½	1	15

An appreciable gain in fire resistance is secured by increasing the gypsum content of the plaster from the 1:3 to the 1:2 proportion. The gypsum in the plaster aids materially in retarding the temperature rise in the partition, since the hydrated plaster, $CaSO_4.2H_2O$, is changed by loss of combined water to $CaSO_4.\frac{1}{2}H_2O$ (plaster of Paris) or $CaSO_4$, depending on the temperature. This molecular change absorbs heat and the vaporization of the water set free further retards the temperature rise, particularly above 100 °C. (212 °F.). The 2½-inch solid partition is seen to give nearly the same fire resistance as the hollow 4½-inch partition. The former is less expensive to construct, although proper proportion and consistency of plaster must be used if sagging of unset plaster is to be prevented where the full thickness is applied over the scratch coat in one day.

The partitions (4 feet 2 inches square) were smaller than the minimum size required for a standard test, but in the case of the partitions concerned it is believed that this will not introduce very significant differences in results. Well-set gypsum plaster applied on metal lath is not subject to spalling or similar disruptive effects on exposure to fire. These effects where they do occur are more likely to be destructive to the larger panel. No indication of spalling or separation of coats appeared in any of the partitions tested.

No hose stream was applied in the tests, ability to resist which is one of the requirements for a partition construction. Similar partitions have, however, been subjected to hose streams in tests elsewhere, with indications of resistance sufficient for the classifications involved.

Further information on the above points will be developed in a series of fire tests of interior partitions to be undertaken in the bureau's new wall furnace which is now being constructed. This will accommodate a partition 16 feet wide and 11 feet high. Means are being provided for applying load to bearing partitions, as well as for conducting hose-stream tests.

EQUIPMENT FOR SOFTENING POINT (P. C. E.) DETERMINATIONS

A paper describing an electric furnace for softening point determinations was published in the May, 1925, issue of the Journal of the American Ceramic Society.

Several minor improvements to the equipment made some months ago have greatly facilitated the making of P. C. E. determinations. These changes are herein described. Formerly the pat containing the pyrometric cones was placed on a refractory block of sufficient height to reach the hottest zone in the furnace and the whole elevated into the muffle of the furnace by hand. A clearance of only one-fourth inch between the periphery of the cone pat and the muffle of the furnace required skillful manipulation in order to avoid bruising or breaking the cones. At present the refractory piece, on which the cone pat is placed, is permanently fastened to a vertical screw having a quarter-inch thread. Elevating the cone pat into the muffle is thereby easily accomplished without danger to injuring the cones.

In addition, the table on which the cone pat rests is rotated during the test. A variable speed motor permits the con-

trol of speed of rotation of the table, which at present is permitted to rotate approximately three revolutions per minute. The rotation of the cone pat is desirable because of hot spots which frequently develop in the walls of the furnace muffle. Inaccuracies in the reporting of P. C. E. determinations are apt to creep in because these hot spots result in differences of temperatures surrounding the cones. By rotating the cone pat the cones apparently receive the same heat treatment since the degree of softening of the several cones of unknown material is identical regardless of their position in the cone pat.

A STUDY OF DESIGN FACTORS OF HOLLOW-WARE DIES

In the bureau's study of machines for extruding clay columns, the first part of the investigation pertaining to brick dies has been completed, and the results were published in the Bureau of Standards Journal of Research (Vol. 1, No. 6, p. 1023; December, 1928).

The second part of the investigation concerning the design factors of hollow-ware dies has been undertaken, and in connection with this investigation a study of methods of lubrication is also being made.

Special equipment has been developed for studying taper and length of dies and cores, and also for determining the moisture content and density of the molded product.

Data obtained indicate that the most efficient hollow-tile die, expressed in quality of product and economy of power consumption, is not over 3 inches long, with cores not over 1½ inches long, both cores and die having a taper of approximately 3°; that is, an angle whose tangent is 0.0524.

Taper affects column structure more than it does power consumption. Both core and die length have a marked effect on power consumption without producing a proportional improvement in column structure. Hollow-ware dies that are too short produce columns with transverse cracks and torn corners.

Design information obtained from a number of preliminary lubrication tests, in which an improvised lubricated hollow-tile dies was used, has been incorporated in the construction of an experimental hollow-tile die having the ingress tapered 6° for a length of 3 inches, the remaining 3 inches of length being straight. The egress of this die can be reduced to 1 inch in length in steps of one-half inch.

Data obtained in recent tests where compressed air, steam, water, and oil were used as lubricating agents introduced 5 inches back of the egress indicate that steam and air are the most efficient for increasing output and decreasing power consumption without detriment to column structure. The other two lubricants are each substantially equal in reducing power consumption, but noticeably less in this respect than steam or air.

The maximum working pressures of the four lubricants as measured at the die in pounds per square inch in sequence with the extrusion tests and flow tests are: Compressed air, 16; steam, 12; water, 10; and oil, 10. The corresponding flow pressures of the material measured in pounds per square inch required to extrude through a half-inch orifice are approximately 46, 50, 55, and 56. The gradual increase in flow pressure and corresponding internal die pressure were largely the result of a gradual total moisture drop of about 1 per cent as the material was repeatedly extruded. The two compressible lubricants are injected at about one-third and one-fourth the corresponding flow pressure, respectively, whereas it was necessary to inject the two liquids at pressures about one-fifth the flow pressure in order to prevent injury to the clay colunm caused by excessive lubricant pressure. Sufficient data have not been obtained up to the present time to warrant making definite deductions regarding lubrication.

ERROR IN ITEM ON CEMENT REFERENCE LABORATORY

The item on pages 93 and 94 of Technical News Bulletin No. 150 contained several errors. The following corrections should be made:

Page 93, column 2, line 7, for "±00.1 mm" read "±0.01 mm."

Page 93, column 2, line 21, for "½ inch" read "$\frac{1}{2}$ inch."

Page 94, column 1, line 11 from bottom, for "1.000 g" read "1,000 g."

Page 94, column 2, at end of the article insert the following:

The inspectors are also requiring that the rollers of the tensile machine grips have a diameter of 0.50 inch ±0.01 inch, that the distance between rollers be 1.25 inches ±0.02 inch, and that the rollers be parallel within 0.02 inch.

FIBER WALL BOARDS

A paper entitled "A Study of Fiber Wall Boards for the Purpose of Developing Specification Standards" was published in the September 26 issue of Paper Trade Journal (10 East Thirty-ninth Street, New York, N. Y.).

In the formulation of purchase specifications for fiber wall board considerable

research was necessary, and the results thus secured are reported in this paper. Products of 10 manufacturers, representative of all types of boards, both laminated and homogeneous, were used in the tests.

In the case of wall boards, moisture resistance and strength are of prime importance. A high degree of moisture resistance is required to counteract the tendency of the boards to warp and to protect them from molding and other influences of dampness. Rosin sizing incorporated throughout the boards appears to be necessary to make them sufficiently moisture resistant. This property is commonly measured by finding the amount of water absorbed in a given time when specimens are immersed in water. But the water-absorption value has no direct relation to the expansion value of a board, and, consequently, gives no information on probable resistance to warping, as warping is due directly to excessive expansion. For this reason an expansion test is considered necessary, and a method was developed for making the test. A flexural breaking test was chosen for measuring strength.

The paper includes a résumé of a previous research by Clark and Conley which served as a basis for the present work, test data for current products, and recommendations concerning the formulation of specifications.

RUBBER FLOOR TILE

The bureau receives many requests for information on the characteristics of rubber floor tile as compared with other types of floorings. As an answer to such questions, Letter Circular No. 270, Rubber Floor Tile, has been prepared. This letter circular presents the conclusions reached as a result of various tests made on samples of floor tile, together with general observations of floor tile in actual use. Copies of Letter Circular No. 270 may be obtained from the bureau on request.

SUNCHECKING OF RUBBER

During the past few years there has been considerable activity in the rubber industry to develop materials which, when added to rubber compounds, will retard deterioration. Several materials now employed are of decided advantage to rubber articles stored or used where there is but little exposure to sunlight. Protection from sunlight apparently demands a different type of material. During the summer months a test was made at the bureau on a commercial material designed to prevent, or at least retard, the cracking and checking of rubber compounds exposed to the sun. Samples of rubber tubing were made containing antichecking material as well as with some containing a wax commonly used for this purpose.

With the tubing under a slight tension, checking was apparent on plain samples within 15 days, while those containing "anticheckers" or large amounts of wax showed none for at least 90 days. Waxes in the amounts necessary to prevent sunchecking have a tendency to "bloom" to the surface—a feature which is objectionable on some rubber articles. Although no particular investigation has been made of the "blooming" characterisitcs of commercial antichecking materials, our tests indicate that they might be used in many places where the surface bloom of wax would be objectionable.

PAINT FOR STREET SIGNS

The bureau has completed the exposure tests (Technical News Bulletin, No. 149, p. 87; September, 1929) on street-sign panels for the government of the District of Columbia. The specimens consisted of 12 cast-iron panels finished with a black field and gold embossed characters, similar to the street-designation signs used in Washington. The results showed that characters embossed with gold leaf are distinctly superior to those embossed with gold-bronze paint. In general, the black enamel background baked on (cast iron) was more durable than the same enamel air dried. The use of a dark-gray lead paint as a priming coat was not satisfactory. The most satisfactory system of finishing consisted in a coat of red lead next to the bare metal, followed by a coat of black enamel for the background, then the embossed letters covered with a slow-drying size followed by gold leaf.

VISIT OF PAPER TECHNICAL ASSOCIATION TO WASHINGTON

As a part of the fall meeting of the Technical Association of the Pulp and Paper Industry, one day was spent in Washington inspecting the District of Columbia Paper Co.'s mill, the Government Printing Office, and the paper section of the Bureau of Standards. A unique souvenir program was prepared by these three organizations. The District of Columbia Paper Co. furnished the very artistic and appropriate cover, and the program was printed by the Government Printing Office on paper of the currency type made in the Bureau of Standards paper mill. To give the visitors a clear idea of the activities of

the paper section, special demonstrations of the paper making and testing equipment were arranged, and research work in progress was explained.

CONSTRUCTION ACTIVITY DURING SEPTEMBER, 1929

The value of construction contracts awarded in 37 Eastern States during September, 1929, as reported by the F. W. Dodge Corporation, was $445,412,000, a total of 24 per cent less than in September, 1928, and below 1927 and 1926 by 15 and 21 per cent, respectively. The value of commercial building contracts showed an increase of 28 per cent, and awards for public buildings were more than three times as great as a year ago, while contracts for residential construction were 42 per cent less. Contracts for industrial construction were valued at 54 per cent less than last September, when the volume of such contracts was exceptionally large.

The cumulative value of contracts awarded during the first nine months of the year was $4,618,538,000, a decline of 10 per cent in comparison with $5,134,844,000 in 1928, but only 4 and 5 per cent less than in 1927 and 1926, respectively. Last year's totals for the corresponding period were exceeded only in Minneapolis and Southeastern districts. Of the principal classes of construction, contracts for public works and utilities were greater than last year by 2 per cent, for commercial buildings by 7 per cent, and for industrial construction by 19 per cent, while those for residential buildings showed a 28 per cent decline.

CITY PLANNING AND ZONING

The bureau's records now show more than 800 municipalities throughout the United States, with a population of over 39,000,000, that have zoning ordinances in effect. Substantial progress is being made on a pamphlet on the Preparation of Zoning Ordinances, and on a list of references relating to community facilities, a part of the program of cooperation with the General Federation of Women's Clubs.

NEW AND REVISED PUBLICATIONS ISSUED DURING OCTOBER, 1929

Journal of Research [1]

Bureau of Standards Journal of Research, Title-page and index to Volume 2, January to June, 1929 (RP Nos. 37 to 76, inclusive). Free on application to the Bureau of Standards.

Bureau of Standards Journal of Research, Vol. 3, No. 4, October, 1929 (RP Nos. 108 to 111, inclusive). Obtainable only by subscription. (See footnote.)

Research Papers [1]

(Reprints from Journal of Research)

RP77. A course-shift indicator for the double-modulation type radiobeacon; H. Diamond and F. W. Dunmore. Price, 5 cents.

RP78. Relative visibility of luminous flashes from neon lamps and from incandescent lamps with and without red filters; F. C. Breckenridge and J. E. Nolan. Price, 5 cents.

RP79. A crystalline difructose anhydride from hydrolyzed inulin; R. F. Jackson and Sylvia M. Goergen. Price, 5 cents.

RP80. Fastness of dyed fabrics to dry cleaning; A. S. Eichlin. Price, 5 cents.

RP82. Improvements in the preparation of aldonic acids; C. S. Hudson and H. S. Isbell. Price, 5 cents.

RP83. Note on the ratio of the electromagnetic to the electrostatic unit of electricity as compared to the velocity of light; H. L. Curtis. Price, 5 cents.

RP84. Bunsen flames of unusual structure; F. A. Smith and S. F. Pickering. Price, 5 cents.

RP85. A study of sheathing papers; F. T. Carson and F. V. Worthington. Price, 5 cents.

RP86. Use of 8-hydroxyquinoline in separation of aluminum; G. E. F. Lundell and H. B. Knowles. Price, 5 cents.

RP87. Removal of dissolved gases from liquids by vacuum sublimation; J. S. Hibben. Price, 5 cents.

RP88. Some absorption properties of clay brick; L. A. Palmer. Price, 10 cents.

RP91. Efficiency of machinists' vises; H. L. Whittemore and R. L. Sweetman. Price, 10 cents.

RP92. Effect of service on endurance properties of rail steels; J. R. Freeman, jr., and H. N. Solakian. Price, 20 cents.

RP93. The structure of alpha-methylxyloside; F. P. Phelps and C. B. Purves. Price, 5 cents.

RP94. The mutual inductance of two parallel circles; Chester Snow. Price, 5 cents.

RP95. Soil-corrosion studies 1927–28; K. H. Logan. Price, 10 cents.

RP96. Photoionization of some alkali vapors; F. L. Mohler and C. Boeckner. Price, 5 cents.

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[1] See footnote 1 on p. 113.

RP97. Making the glass disk for a 70-inch telescope reflector; A. N. Finn. Price, 10 cents.
RP98. Effect of water on expansions of ceramic bodies of different composition; H. G. Schurecht and G. R. Pole. Price, 5 cents.
RP99. Thermoelectric temperature scales; W. F. Roeser. Price, 5 cents.
RP100. Light fastness of lithographic ink pigments; W. D. Appel and R. F. Reed. Price, 10 cents.
RP101. Effect of oxidizing conditions on accelerated electrolytic corrosion tests; H. S. Rawdon and W. A. Tucker. Price, 10 cents.
RP102. Representation of aberration diffraction effects by means of rotating sectors; A. H. Bennett. Price, 10 cents.
RP103. Hot aqueous solutions for the quenching of steels; H. J. French and T. E. Hamill. Price, 15 cents.
RP104. Preparation of experimental sagger bodies according to fundamental properties; R. A. Heindl and L. E. Mong. Price, 10 cents.
RP105. A suppressed-zero electrodynamic voltmeter; F. K. Harris. Price, 5 cents.
RP106. Two isomeric crystalline compounds of *d*-mannose with calcium chloride; J. K. Dale. Price, 5 cents.
RP107. A study of purified wood fibers as a paper-making material; R. H. Rasch. Price, 15 cents.

Circulars [1]

C375. Weights per United States gallon and weights per cubic foot of sugar solutions. Price, 5 cents.

Simplified Practice Recommendations [1]

R75–29. Composition blackboard (second edition). Price, 5 cents.
R88–29. Floor sweeps. Price, 5 cents.

Miscellaneous Publications [1]

M95. Protection of electrical circuits and equipment against lightning. Preliminary report of the sectional committee on protection against lightning. Price, 25 cents.

Federal Specifications [1]

(Promulgated by Federal Specifications Board)

FS61b. Rope, manila. Price, 5 cents.
FS301a. Sheeting, cotton, unbleached. Price, 5 cents.
FS422a. Towels, huck, office (with woven name). Price, 5 cents.
FS615a. Ticking, mattress and pillow. Price, 5 cents.

Commercial Standards Monthly [1]

CSM. Vol. 6, No. 4, October, 1929. Obtainable only by subscription. (See footnote.)

Technical News Bulletin [1]

TNB151. Technical News Bulletin, November, 1929. Obtainable only by subscription. (See footnote.)

OUTSIDE PUBLICATIONS [2]

Lightning. M. G. Lloyd; Bulletin of the Underwriters' Laboratories (Chicago, Ill.), Vol. 10, No. 8, p. 171; August, 1929.

The Code. M. G. Lloyd; Electrical Record (New York, N. Y.), Vol. 46, p. 83; October, 1929.

Some laboratory experiments for the dental school. Wilmer Souder; Journal, American Dental Association (Chicago, Ill.), Vol. XVI, No. 10, p. 1829; October, 1929.

Measuring petroleum cargoes. L. J. Briggs and George K. Burgess; The Petroleum News (London, England), Vol. XXII, No. 563, p. 806; October 26, 1929.

Safeguarding the storage of photographic, motion picture, and X-ray films. C. R. Brown; Fire Protection Cincinnati, Ohio), Vol. 94, No. 8, p. 14; September, 1929.

Horsepower correction for atmospheric humidity. D. B. Brooks; Society of Automotive Engineers Journal (New York, N. Y.), Vol. XXV, No. 3, p. 277; September, 1929.

Relations between rotatory power and structure in the sugar group. Part XX. Two isomeric crystalline compounds of d-mannose with calcium chloride. J. K. Dale; Journal, American Chemical Society (Washington, D. C.), Vol. 51, p. 2788; 1929.

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[1] Send orders for publications under this heading with remittance only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 25 cents per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, 40 cents. Subscription to Bureau of Standards Journal of Research, $2.75; other countries, $3.50. Subscription to Commercial Standards Monthly, $1; other countries, $1.25.

[2] "Outside publications" are not for distribution or sale by the Government. Requests should be sent direct to publishers.

Applied inorganic analysis. (A reference text of 929 pages; price $8.50.) W. F. Hillebrand and G. E. F. Lundell; John Wiley & Sons (New York, N. Y.); September, 1929.

A comparison of methods used for the determination of moisture in textiles. H. A. Hamm and D. A. Jessup; American Dyestuff Reporter (New York, N. Y.), Vol. XVIII, No. 7, p. 637; September 30, 1929.

Research on textiles. H. D. Hubbard; American Dyestuff Reporter (New York, N. Y.), Vol. XVIII, No. 7, p. 662; September 30, 1929.

Emploi de l'extrait sulfite de cellulose comme matière tannante. E. L. Wallace and R. C. Bowker. Translation into French of Technologic Paper No. 339. Société l'Avébène (13 Rue d'Aguesseau, Paris, France), October, 1929.

Current metallurgical research at the Bureau of Standards. H. S. Rawdon; Metals and Alloys (New York, N. Y.), Vol. 1, No. 4, p. 144; October, 1929.

The action of soils on metallic iron. H. D. Holler; Journal, Washington Academy of Sciences (Washington, D. C.), Vol. 19, p. 371; October, 1929.

Progress report on investigation of fire clay brick and the clays used in their preparation. R. A. Heindl and W. L. Pendergast; Journal, American Ceramic Society (Columbus, Ohio), Vol. 12, No. 10, p. 640; October, 1929.

Simplified practices produce results in the electric railway industry. E. W. Ely; AEIA (292 Madison Ave., New York, N. Y.), Vol. XX, p. 594; October, 1929.

Simplified practice, a factor in cost work. E. W. Ely; Typothetae Bulletin (Washington, D. C.), Vol. XXX, No. 2, p. 57; October 14, 1929.

The speed record of the universe. Paul R. Heyl; Scientific American (New York, N. Y.), Vol. 141, No. 5, p. 414; November, 1929.

Revising the style manual. An introductory analysis of the problem and development of proposed policy and procedure presented on invitation of Hon. George H. Carter, Public Printer, before the advisory group organized for the revision of the Style Manual of the Government Printing Office on October 18, 1929. H. D. Hubbard (Bureau of Standards, Washington, D. C.); October, 1929.

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